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(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 668 173 A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 95102220.1

(51) Int. Cl.6: B60C 11/04, B60C 11/12

(22) Date of filing: 17.02.95

(30) Priority: 22.02.94 IT MI940309

(43) Date of publication of application:
23.08.95 Bulletin 95/34

(84) Designated Contracting States:
AT DE ES FR GB SE

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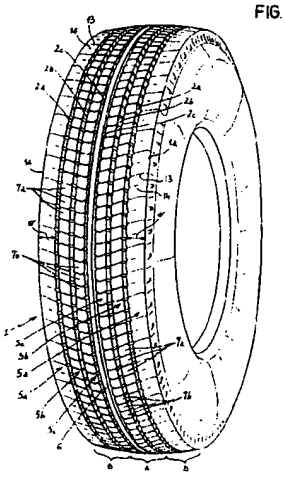
(54) Medium/heavy duty motor-vehicle tyres provided with a tread of the universal type.

(57) In a tyre tread band for medium/heavy duty motor-vehicles a tread band is provided with circumferential grooves (2a, 2b, 2c) confining three pairs of respectively centre (5c), intermediate (5b) and shoulder ribs (5a). Respective blocks (7b, 7a) are defined along the centre and intermediate ribs and they are confined by transverse cuts (8b, 8a). The centre cuts (8b) impart a cusp-shaped end conformation (9) and a hollow-shaped end conformation (10) to the respective blocks (7b), and the shapes of said end portions mutually match. The intermediate cuts (8a) run in the linear extension of the centre cuts (8b) to give the respective blocks a rhomboidal configuration. The tyre can be alternately associated with a driving axle or a driven axle, by merely reversing its direction of rotation, so that the following results are selectively achieved: an increase in the traction capability by the intermediate blocks or an increase in the directional capability as a result of the mutual wedging between the centre blocks at the ground-contacting area.

FIG.1



EP 0 668 173 A1

The present invention relates to a tyre tread band for medium/heavy duty motor vehicles, comprising at least one pair of circumferential shoulder ribs confined between respective side edges of the tread band and respective circumferential shoulder grooves axially spaced apart from the side edges; at least one pair of intermediate circumferential ribs respectively confined between the shoulder grooves and corresponding intermediate circumferential grooves axially spaced apart from the shoulder grooves themselves; at least one centre rib extending circumferentially between said intermediate grooves, each of said intermediate and centre ribs being divided into a plurality of respectively intermediate and centre raised reliefs or blocks, circumferentially defined by respectively intermediate and central transverse cuts of a width lower than 1 mm.

It is known that medium/heavy duty motor vehicles, such as trucks, articulated lorries and the like are usually equipped with tyres of different typologies on the driving and driven axles respectively, due to the different requisite behaviour and operation qualities of the tyres, taking into account the different conditions of use of same.

In particular, tyres associated with the driving wheels must exhibit as the fundamental quality, a high traction capability on any type of road, in addition to excellent uneven wear resistance for achieving a high kilometric output. To this end, tyres are used the tread band of which is of the type provided with a plurality of blocks defined by the combination of circumferential grooves intersecting transverse grooves of an important width, usually in the order of 5 mm, oriented according to an angle generally larger than 45° with respect to the direction of the circumferential extension thereof. The sizes and orientation of the transverse grooves greatly affect the grip action exerted by the tyre on the ground in relation to the tangential efforts connected with the transmission of the motive force.

The state of the art also suggests different construction expedients to be employed on driving or tractive tyres mainly in cars, for the purpose of improving the operating features thereof. For example, European Patent EP 0 498 287 discloses a tread band provided with five rows of blocks, to be respectively identified as a centre row disposed on the equatorial plane of the tyre, two shoulder rows disposed along the opposite side edges of the tread band, two intermediate rows each being interposed between the centre row and one of the shoulder rows. For the purpose of improving the wear evenness of the blocks, the transverse grooves associated with the shoulder and centre block rows exhibit a given angle of incidence relative to a direction normal to the tread band surface, which angle of incidence has respectively contrary directions between the grooves of the shoulder rows and those of the centre row. It is also pointed out that two opposite ways of rotation are provided for such a tread band, depending on whether the corresponding tyre is mounted to a traction axle or a driven axle of the motor-vehicle, taking into account the opposite orientations of the reaction forces exchanged with the ground in the two different use situations.

Patent GB 2 093 777 in turn describes a tyre for cars, particularly adapted to run on road-beds covered with snow the tread band of which is divided into five circumferential ribs, identified as a centre rib, a pair of intermediate ribs and a pair of shoulder ribs, integrally passed through by thin grooves and transverse cuts oriented obliquely to the circumferential extension direction. The grooves and cuts arranged in the intermediate and shoulder ribs have a predetermined angle of incidence relative to the normal to the external surface of the tread band, for the purpose of improving the grip action of the tread band on the road-bed covered with snow. In order that the rolling direction of the tyre will not affect the traction features thereof, it is provided that the incidence of the grooves and cuts made in one of the shoulder ribs and one of the intermediate ribs be opposite from that of the grooves and cuts belonging to the other shoulder rib and other intermediate rib.

Referring now to tyres mounted on the driven axles of medium/heavy duty motor-vehicles, it is noted that the main feature required from them is a high directional control stability, together with a good abrasion resistance and wear unevenness resistance, as well as a remarkable elimination of water from the imprint or track area in case of running on a wet road-bed.

In the connection tyres having a tread band of the "furrowed" type are used, that is provided with circumferential straight or zigzag grooves defining a plurality of circumferential ribs in the tread band, which ribs are optionally passed through by transverse cuts of limited width.

European Patent EP 0 384 182 exactly describes a tyre for medium/heavy duty motor-vehicles having a tread band of the "furrowed" type, exhibiting five or more circumferential ribs confined by corresponding circumferential zigzag grooves. Each rib, apart from the shoulder ribs defining the opposite side edges of the tread band, is divided into a plurality of blocks circumferentially defined by transverse cuts less than 3 mm wide. The transverse cuts of each rib are located in a circumferentially offset position relative to those of the adjacent rib and have an angle of incidence included between 5° and 25° relative to a direction normal to the external tread band surface. The rotational direction of the tyre is such that on running the reactions transmitted from the ground to the ground-contacting area of the tread band tend to reduce the

inclination of the transverse cuts relative to the normal to the tread band surface, for the purpose of achieving a greater wear evenness in the blocks, thereby avoiding the so-called "saw-tooth" wear phenomenon.

The foregoing being stated, due to the fact that at the present state of the art the tread band pattern adopted for traction tyres and driven or free rolling tyres respectively is specific for each of them, the use of one and the awe type of tyre for the whole equipment of a medium/heavy duty motor-vehicle cannot be proposed.

In accordance with the present invention, it has been found that the above goal could be achieved by distinguishing in the width of a tread band, different portions particularly adapted to selectively perform directional and tractive functions and imposing contrary rotational directions to the tyre for the purpose of accomplishing one or the other function, so that one and the same tyre will be indifferently used on a tractive axle or a driven axle by merely reversing its direction of rotation.

In particular, the invention relates to a tyre tread band for medium/heavy duty motor-vehicles, characterized in that the transverse centre cuts define, in the axial extension of the tread band, at least one directional circumferential area confined between the intermediate grooves, in which said centre blocks lend themselves to be linked up one after the other by effect of elastic deformations induced therein by the reactions transmitted from the ground when the tread band rotates in a given directional rolling direction, said intermediate cuts defining, at laterally opposite positions relative to the directional area, at least two tractive circumferential areas in which at least the intermediate blocks mutually diverge by effect of the elastic deformations induced by the reactions transmitted from the ground when the tread band rotates in a tractive rolling direction contrary to the directional rolling direction.

To this end the centre cuts define, at circumferentially opposite positions on each centre block, a cusp-shaped end portion turned in the directional rolling direction, and a hollow-shaped end portion the shape of which matches that of the cusp-shaped end portion.

The intermediate transverse cuts give each of the intermediate blocks a substantially rhomboidal configuration. In greater detail, each centre cut has first and second consecutive stretches extending obliquely according to respectively opposite orientations relative to the circumferential extension direction of the tread band, in order to impart said cusp-shaped end conformation and said hollow-shaped end conformation to each centre block, whereas the intermediate cuts are directed obliquely to the circumferential extension direction concordantly with the orientation of the adjacent stretches of the centre cuts, in order to impart a substantially rhomboidal configuration to the respective intermediate blocks.

Preferably two of said centre ribs are provided and they are disposed symmetrically to the equatorial plane of the tread band and mutually separated by at least one auxiliary circumferential groove.

In particular, two of said auxiliary circumferential grooves are provided and they define an auxiliary circumferential scooped portion symmetrically centered relative to said equatorial plane.

Advantageously, each of the intermediate cuts extends in the rectilinear extension of the adjacent stretch of one of the centre cuts, the first stretches of the centre cuts and the intermediate cuts forming an angle of inclination included between 10° and 35° with the circumferential extension direction.

The second stretches of the centre cuts exhibit, relative to the circumferential extension direction, an angle of inclination included between 15° and 40°.

According to a further feature of the invention, the intermediate and centre cuts extend obliquely in the thickness of the corresponding ribs, forming respective angles of incidence relative to a direction normal to the outer tread band surface.

Preferentially, the angle of incidence formed by each centre cut is oriented so as to substantially form an undercut close to the cusp-shaped end portion of the corresponding centre block, and the angle of incidence formed by the intermediate cuts is correspondingly opposite to the angle of incidence formed by the centre cuts.

Advantageously, each of said angles of incidence, in a plane normal to the extension direction of said cuts on the external tread band surface has a value included between 3° and 10°.

Each of said centre and intermediate cuts preferentially has a width included between 0.3 mm and 1.5 mm and a depth substantially corresponding to that of the adjacent circumferential grooves.

In turn, the shoulder, intermediate and auxiliary grooves have a depth included between 11 mm and 18 mm.

In addition, each of said shoulder, intermediate and auxiliary grooves is 2 mm to 15 mm wide on the external surface of the tread band.

Preferably, each of said shoulder grooves has an external portion opening onto the external tread band surface according to a width included between 5 mm and 12 mm, as well as an internal portion of a width lower than 2 mm and exhibiting a depth in the order of from 1/8 to 2/5 of the overall depth of the shoulder

groove itself.

In addition, each of said intermediate grooves is conceived so that its width is greater than the width of the shoulder and auxiliary grooves.

In a preferential solution, each shoulder rib has surface sipes (small cuts) running in the extension of the intermediate cuts and having a varying profile in right section and a depth not higher than 5 mm.

Finally, the centre and intermediate ribs are provided to substantially be of the same width, included between 1/11 and 1/6 of the overall width of the tread band.

Further features and advantages will become more apparent from the detailed description of a preferred embodiment of a tread band for medium/heavy duty motor-vehicles in accordance with the present invention, given hereinafter by way of non-limiting example with reference to the accompanying drawings, in which:

- Fig. 1 is a perspective view of a tyre provided with a tread band in accordance with the invention;
- Fig. 2 is a plan view of a circumferential portion of the tread band in reference;
- Fig. 3 is an interrupted sectional view taken along line III-III in Fig. 2;
- Fig. 4 is an interrupted sectional view taken along line IV-IV in Fig. 2;
- Fig. 5 is an interrupted sectional view taken along line V-V in fig. 2.

Referring to the drawings, a tyre tread band for medium/heavy duty motor-vehicles in accordance with the present invention has been generally identified by reference numeral 1.

It is pointed out that the size parameters reproduced in the progress of the present description refer, by way of example only, to a tread band associated with a new tyre size 315/80R22.5", mounted to the appropriate rim and inflated to the use pressure.

The tread band 1, associated with a tyre the remaining construction parts of which are not described as known and not of importance to the ends of the invention, has a plurality of circumferential grooves 2a, 2b, 2c axially spaced apart from each other, disposed symmetrically to the equatorial plane m-m of the tread band itself and having, just as an indication, a width included between 2 mm and 15 mm, and a depth in the range of 11 mm to 18 mm. More particularly, provision is made for at least one pair of shoulder grooves 2a having a given width L' axially spaced apart from respective opposite side edges 1a of the tread band 1, at least one pair of intermediate grooves 2b, preferably having a width L'' greater than that of the shoulder grooves 2a and axially spaced apart from the shoulder grooves towards the equatorial plane m-m, as well as one or more auxiliary grooves 2, of width L''' and located at a central position relative to the tread. In greater detail, said widths L', L'', L''' respectively correspond to 6.5 mm for shoulder grooves 2a, 8.5 mm for intermediate grooves 2b, and 4.5 mm for auxiliary grooves 2c, the latter preferably being two in number and disposed symmetrically to the equatorial plane m-m.

As shown in Fig. 5, each of the shoulder grooves 2a exhibits, seen in right section, an external portion 3 opening onto the outer surface of the tread band 1 according to the above specified width L', and a lower portion 4 of a width lower than 2 mm and a depth included between 1/8 and 2/5 of the overall depth of the groove itself.

The presence of grooves 2a, 2b, 2c gives rise to a plurality of circumferential ribs 5a, 5b, 5c disposed consecutively in axial side by side relation. More particularly, provision is made for at least one pair of shoulder ribs 5a each confined between one of the side edges 1a and one of the shoulder grooves 2a, one pair of intermediate ribs 5b each confined between one of the shoulder grooves 2a and one of the intermediate grooves 2b, as well as one or more centre ribs 5c confined between the intermediate grooves 2b. In the embodiment shown, a pair of centre ribs 5c is provided and each of them is confined between one of the intermediate grooves 2b and one of the auxiliary grooves 2c. In addition, a continuous scooped portion 6 is defined between the auxiliary grooves 2c and it extends circumferentially at a centered position relative to the equatorial plane m-m.

As clearly shown in Fig. 2, the intermediate and centre ribs exhibit widths W'' and W''' substantially of same value, preferably corresponding to 26 mm and at all events included between 1/11 and 1/6 of the overall width of the tread band 1.

In turn, the shoulder ribs have a width W' substantially equal to 42 mm and preferably greater than the width of each one of the intermediate and centre ribs 5b and 5c. The central scooped portion 6 is 13 mm wide and at all events its width preferably should be lower than the width of each one of the intermediate and centre ribs 5b and 5c.

The intermediate and centre ribs 5b and 5c are each divided into a plurality of intermediate and centre blocks, 7a and 7b respectively, defined by intermediate and centre transverse cuts 8a and 8b which preferably substantially have the same depth than the circumferential grooves 2a, 2b and 2c and whose width "l" corresponds to 0.6 mm and at all events is smaller than 1 mm.

In accordance with the present invention, the intermediate and centre cuts 8a and 8b are such shaped and disposed that in the axial extension of the tread band 1 several operatively differentiated areas are defined which are designed to perform their functions selectively depending on the rolling direction imposed to the tyre. In greater detail, the centre cuts 8b are shaped so as to define a directional circumferential area "A", confined between the intermediate grooves 2b, in which the centre blocks 7b lend themselves to link up one after the other by effect of elastic deformations induced therein by the reactions transmitted from the ground when the tread band 1 rotates according to a predetermined directional rolling direction marked by arrow "C".

To this end, the centre cuts 8b are such shaped that in each centre block 7b there is defined, at circumferentially opposite positions, a cusp-shaped end portion 9 directed in the above directional rolling direction "C" and a hollow-shaped end portion 10 the shape of which matches that of the cusp-shaped end portion 9 and which is immediately followed by the cusp-shaped portion of the subsequent centre block 7b.

To this end, each centre cut 8b is essentially defined by first and second consecutive stretches 11, 12 extending obliquely according to respectively opposite orientations relative to the circumferential extension direction of the tread band 1.

Preferentially, the first and second stretches 11, 12 of each cut 8b form with the circumferential direction of the tread band 1, angles of inclination α' and α'' of 20° and 30° respectively, and in any event preferably in the range of 10° to 30° and 15° to 45°, respectively. The junction point between the first and second stretches 11, 12 is preferably offset relative to the centre line of the transverse extension of the corresponding centre rib 5c, moving close to the equatorial plane m-m. In greater detail, the distance between the junction point between the first and second stretches 11, 12 and the circumferential edge of the corresponding centre rib 5c is provided to be included between 1/4 and 3/4 of the overall width W''' of the centre rib itself.

In turn, the intermediate cuts 8a are so shaped and arranged that they define two tractive areas "B", included in the gap confined between each of the intermediate grooves 2b and the corresponding side edge 1a of the tread band 1, in which at least the intermediate blocks 7a mutually diverge upon effect of the elastic deformations induced by the reactions transmitted from the ground when the tread band 1 rotates in a tractive rolling direction "T" contrary to said directional rolling direction "C".

To this end, the intermediate transverse cuts 8a are directed obliquely to the circumferential extension direction of the tread band, concordant with the orientation of the adjacent first stretches 11 of the centre cuts 8b, so that a substantially rhomboidal configuration is imparted to the intermediate blocks 7a. More particularly, each of the intermediate cuts 8a is provided to form, with the circumferential extension direction, an angle α''' included between 10° and 35° and, in a preferential solution, to run in the extension of the adjacent stretch of one of the centre cuts 8b.

The circumferential distribution pitch of the intermediate and centre cuts 8a and 8b preferably corresponds to 0.8% of the circumferential extension of the tyre measured at the equatorial plane m-m, and in any event included between 0.6% and 1.1% of said circumferential extension.

Preferentially, each of the shoulder ribs 5a is crossed by surface sipes 13 respectively running in the extension of the intermediate cuts 8a, at the rate of one sipe 13 every two intermediate cuts 8a.

Such sipes preferably are 2 mm deep and the value of their depth increases at a narrow central area of the longitudinal extension thereof, although it never exceeds 5 mm. "Blind lamellae" 14 may be alternated with the sipes 13 and they are oriented parallelly to said sipes and in the example shown they are 5 mm deep; at all events their depth must not exceed that of sipes 13.

In addition, in accordance with a preferential feature of the invention, the intermediate 8a and centre 8b transverse cuts do not extend radially in the thickness of the tread band 1, but they are oriented obliquely in the thickness of the corresponding ribs 5b, 5c, thereby forming a given angle of incidence β preferably of 5° and in any event included between 3° and 10°, relative to a direction "N" normal to the external surface of the tread band 1.

Preferentially, as shown in Fig. 3, the angle of incidence β' formed by each of the centre cuts 8b is inclined towards the inside of the corresponding block 7b, in the cusp-shaped portion 9, so as to substantially form an undercut close to the cusp-shaped end portion itself. It is also preferred for the angle of incidence β'' formed by the intermediate cuts 8a (Fig. 4) to be correspondingly opposite to that formed by the centre cuts 8b.

Advantageously, the opposite incidence given to the intermediate cuts 8a and centre cuts 8b further increases the effects achieved by the tread band 1 in terms of directional and tractive capabilities when the tyre with which it is associated is used on a traction or driving axle or on a driven axle, respectively.

For better clarifying the different operating features selectively achieved by the tread band in reference, depending on the direction of rotation imposed to the tyre, it is useful to note that the reactions transmitted

from the ground to the tread band at the ground-contacting area during the running exhibit respectively opposite directions depending on whether the tyre is mounted to a driven axle and therefore driven in rotation by effect of the contact with the ground, or mounted to a traction axle and therefore submitted to a torque applied to the tyre around its axis of rotation.

More particularly, it has been found that the reactions induced by the ground with reference to the tyre mounted to the driven axle tend to cause the blocks to move close to each other at the ground-contacting area, whereas the tangential forces initialized in the case of a tyre mounted to the traction axle tend to cause a mutual divarication of the blocks.

The foregoing being stated, it will be noted that when mounted to the driven axle, since the tread band 1 is subjected to rotate in the direction marked by arrow "C" in Fig. 2, each of the centre blocks 7b enters the ground-contacting area before the corresponding intermediate block 7a aligned therewith in the extension direction of the transverse cuts 8a. Due to the mutual approaching of the blocks at the ground-contacting area the cusp-shaped portion 9 of each of the centre blocks 7b fits into the hollow-shaped portion 10 of the contiguous block, thereby causing a mutual self-locking of the blocks in the transverse direction. As a result, the centre ribs 5c are stiffened and, also in cooperation with the central scooped portion 6, they achieve exceptional directional and drive steadiness qualities, as well as wear evenness, due to the reduced or negligible mobility of the blocks at the ground-contacting area. The above advantageous effects are increased by the fact that the elastic deformation undergone by the centre blocks 7b under the reaction of the ground will tend to close the centre cuts 8b, so that an advantageous increase in the contact pressure of the blocks on the ground is achieved and, as a result, a further reduction in the mobility of same.

When used on the traction axle, on the contrary, the tread band 1 is subjected to rotate in the tractive direction identified by arrow "T" and the first blocks entering the ground-contacting area are the intermediate blocks 7a. In conclusion, the tractive action at the beginning of the ground-contacting area is progressively generated from the areas closer to the side edges 1a of the tread band towards the equatorial plane m-m. This situation is very advantageous in terms of tractive action, in that the areas close to the side edges, occupied by the shoulder ribs 5a and intermediate ribs 5b respectively, appear to be those where the greatest contact pressure of the tyre on the ground-contacting area occurs, whereas the specific inclination of the cuts promotes the mutual divarication of the intermediate blocks 7a and involves opening of the intermediate cuts 8a, to advantage of the tractive action, so as to ensure an excellent grip even on wet road-beds or road-beds covered with snow.

At the same time, the reactions induced on the centre blocks 7b will tend to reduce the angle of incidence β' of the corresponding centre cuts 8b, thereby giving rise to an advantageous reduction in the contact pressure of the blocks on the ground capable of compensating for the wear effects that otherwise would result from the greater mobility exhibited by the centre blocks 7b under these running conditions.

It will be also noted that the important absence of blocks at the shoulder ribs 5a is capable of imparting an excellent side stability to the tyre even when used as a traction tyre. This effect is increased by the particular configuration in section of the shoulder grooves 2a that, thanks to the presence of the internal portion 4 of reduced width, prevent an excessive side movement of the intermediate blocks 7a. The cross-sectional configuration of the shoulder grooves 2a is also adapted to facilitate the ejection of stones and debris that should be wedged in the shoulder grooves themselves.

From the foregoing it is apparent that the invention achieves the surprising result of enabling the equipment of a complete medium/heavy duty motor-vehicle to be formed of a single type of tyre, by adopting the mere expedient of giving the tyres mounted on the driving axle a direction of rotation contrary to that of the tyres mounted on the driven axle, so as to eliminate the non-negligible problems connected in the known art with the management of different types of tyres for a single motor-vehicle.

In the connection it is pointed out the fact that the tread band according to the present invention is capable of reaching marked traction capability qualities, which are usually required for use in driving wheels, in spite of the absence of transverse grooves of important width, which are on the contrary inevitably adopted in the known art for achieving the desired traction capability qualities. In the connection practical comparison tests carried out by the applicant itself have proved that the tread band in question exhibits traction capability qualities comparable with, and maybe even higher than, those achieved with usual tyres of the tractive type, even on running on road-beds covered with snow.

The table below reproduces the results of traction capability tests conducted on compact snow and fresh snow respectively, with identical industrial vehicles the tractive axles of which are respectively equipped with the following tyres:

(1) Tractive tyre provided with blocks, presently produced by the Applicant

(2) Tractive tyre provided with blocks, manufactured by the best competitive companies

(3) Winter tyre presently produced by the Applicant
(4) Universal tyre, according to the invention.
The reproduced data measure the percent skid of the above tyres under the different use conditions.

	TYRES			
	(1)	(2)	(3)	(4)
ON COMPACT SNOW	22%	20%	18.5%	30%
ON FRESH SNOW	33%	32%	32%	31%

It will be noted that on compact snow the inventive tyre loses some percent points with respect to the comparative tyres, of the specific tractive type, whereas its behaviour is substantially of same level on fresh snow, and this is achieved by virtue of the type of "lamellae" adopted.

In addition, the invention enables the qualities of high directional control and side stability, which are necessarily required when the tyres are to be mounted on driving axles, to be stressed. In this case too, practical comparative tests have proved that the tyres provided with the tread band in reference are of the same level as the best tyres of the "furrowed" type.

The table below reproduces the results of behaviour tests conducted with the same motor-vehicle equipped with the pair of tyres presently produced by the applicant and the tyres according to the invention identified as above:

(1)	Traditional directional tyres Usual tractive tyres provided with blocks	on the driven axle on the drive axle
(2)	Tyres according to the invention Tyres according to the invention	on the driven axle on the drive axle

Data reproduce a subjective evaluation expressed by an inspector for the different features considered.

		EQUIPMENTS	
		(1)	(2)
RUNNING:	Directional control stability		
	on highway roads	6.5	6.0
	on undulating roads	6.0	5.5
DRIVE:	Quickness of response	6.0	5.0
	Graduality	6.0	5.0
	Centering on a bend	6.0	5.0
SIDE STABILITY			
Compliance		5.5	6.0
Controllability		5.0	5.0
Gelatine effect		5.5	6.5

It will be noted that the inventive tyre is lower at the items under "drive", particularly referring to its behaviour on the front axle (directional control capability), whereas it is at the same level or higher as regards side stability. In conclusion, the tyre of the invention solves the problems connected with the use of different tyres on the driven and driving axles without being obliged to renounce the best behaviour qualities offered by traditional tyres.

Under all use situations, in addition, excellent qualities of high abrasion resistance and uneven wear resistance, as well as good road-holding on a wet road-bed are maintained, thanks to the efficient evacuation of water carried out by the wide circumferential grooves 2a, 2b, 2c.

It will be also recognized that, thanks to the absence of transverse grooves of marked width, the tread band in reference is very noiseless and rolls smoothly and is adapted to meet the most recent requirements

tending to limit fuel consumption and sound pollution.

In the connection, practical comparative tests carried out by phonometrically detecting, at a predetermined point, the noise emitted on passing of a motor-vehicle riding at high speed with the engine switched off, have proved that the noise emitted from the tread band in reference can be compared to that of the traditional type patterns and is greatly lower (1 to 4 dB) than that of usual tyres of the traction or driving type including rib-block composite patterns.

Many modifications and variations may be made to the invention as conceived, all of them falling within the scope of the invention as characterized by the appended claims.

Claims

1. A tyre tread band for medium/heavy duty motor vehicles, comprising:
   - at least one pair of circumferential shoulder ribs (5a) confined between respective side edges (1a) of the tread band (1) and respective circumferential shoulder grooves (2a) axially spaced apart from the side edges (1a);
   - at least one pair of intermediate circumferential ribs (5b) respectively confined between the shoulder grooves (2a) and corresponding intermediate circumferential grooves (2b) axially spaced apart from the shoulder grooves themselves;
   - at least one centre rib (5c) extending circumferentially between said intermediate grooves (2b),

   each of said intermediate and centre ribs (5b, 5c) being divided into a plurality of respectively intermediate and centre raised reliefs or blocks (7a, 7b), circumferentially defined by respectively intermediate and central transverse cuts (8a, 8b) of a width lower than 1 mm,
   characterized in that the transverse centre cuts (8b) define, in the axial extension of the tread band (1), at least one directional circumferential area (A) confined between the intermediate grooves (2b), in which said centre blocks (7b) lend themselves to be linked up one after the other by effect of elastic deformations induced therein by the reactions transmitted from the ground when the tread band (1) rotates in a given directional rolling direction (C), said intermediate cuts (8a) defining, at laterally opposite positions relative to the directional area (A), at least two tractive circumferential areas (B) in which at least the intermediate blocks (7a) mutually diverge by effect of the elastic deformations induced by the reactions transmitted from the ground when the tread band (1) rotates in a tractive or driving rolling direction (T) contrary to the directional rolling direction.

2. A tread bend according to claim 1, characterized in that the centre cuts (8b) define, at circumferentially opposite positions on each centre block (7b), a cusp-shaped end portion (9) turned in the directional rolling direction (C), and a hollow-shaped end portion (10) the shape of which matches that of the cusp-shaped end portion (9).

3. A tread band according to claim 2, characterized in that said intermediate transverse cuts (8a) give each of the intermediate blocks (7a) a substantially rhomboidal configuration.

4. A tread band according to claim 2, characterized in that each centre cut (8b) has first and second consecutive stretches (11, 12) extending obliquely according to respectively opposite orientations relative to the circumferential extension direction of the tread band (1), in order to impart said cusp-shaped end conformation (9) and said hollow-shaped end conformation (10) to each centre block (7b).

5. A tread band according to claim 4, characterized in that said intermediate cuts (8a) are directed obliquely to the circumferential extension direction concordantly with the orientation of the adjacent stretches (11) of the centre cuts (8b), in order to impart a substantially rhomboidal configuration to the respective intermediate blocks.

6. A tread band according to claim 1, characterized in that it comprises two of said centre ribs (5c) which are disposed symmetrically to an equatorial plane (m-m) of the tread band (1) and mutually separated by at least one auxiliary circumferential groove (2c).

7. A tread band according to claim 6, characterized in that it comprises two of said auxiliary circumferential grooves (2c) defining an auxiliary circumferential scooped portion (6) symmetrically centered relative to said equatorial plane (m-m).

8. A tread band according to claim 5, characterized in that each of the intermediate cuts (8a) extends in the rectilinear extension of the adjacent stretch (11) of one of the centre cuts (8b).

9. A tread band according to claim 8, characterized in that the first stretches (11) of the centre cuts (8b) and the intermediate cuts (8a) form an angle of inclination included between 10° and 35° with the circumferential extension direction.

10. A tread band according to claim 6, characterized in that the second stretches (12) of the centre cuts (8b) exhibit, relative to the circumferential extension direction, an angle of inclination included between 15° and 40°.

11. A tread band according to claim 3, characterized in that said intermediate and centre cuts (8a, 8b) extend obliquely in the thickness of the corresponding ribs (5b, 5c), forming respective angles of incidence relative to a direction normal to the outer tread band surface.

12. A tread band according to claim 11, characterized in that the angle of incidence formed by each centre cut (8b) is oriented so as to substantially form an undercut close to the cusp-shaped end portion (9) of the corresponding centre block (7b).

13. A tread band according to claim 12, characterized in that the angle of incidence formed by the intermediate cuts (8a) is correspondingly opposite to the angle of incidence formed by the centre cuts (8b).

14. A tread band according to claim 11, characterized in that each of said angles of incidence, in a plane normal to the extension direction of said cuts (8a, 8b) on the external tread band surface, has a value included between 3° and 10°.

15. A tread band according to claim 1, characterized in that each of said centre and intermediate cuts (8b, 8a) has a width included between 0.3 mm and 1 mm.

16. A tread band according to claim 1, characterized in that each of said centre and intermediate cuts (8b, 8a) has a depth substantially corresponding to that of the adjacent circumferential grooves (2a, 2b, 2c).

17. A tread band according to claim 6, characterized in that each of said shoulder, intermediate and auxiliary grooves (2a, 2b, 2c) has a depth included between 11 mm and 18 mm.

18. A tread band according to claim 6, characterized in that each of said shoulder, intermediate and auxiliary grooves (2a, 2b, 2c) is 2 mm to 15 mm wide on the external surface of the tread band (1).

19. A tread band according to claim 18, characterized in that each of said shoulder grooves (2a) has an external portion (3) opening onto the external tread band surface according to a width included between 5 mm and 10 mm, as well as an internal portion (4) of a width lower than 2 mm and exhibiting a depth in the order of from 1/8 to 2/5 of the overall depth of the shoulder groove itself.

20. A tread band according to claim 19, characterized in that each of said intermediate grooves (2b) has a width greater than the width of the shoulder groove (2a).

21. A tread band according to claim 1, characterized in that each shoulder rib (5a) has surface sipes (small cuts) (13) running in the extension of the intermediate cuts (8a) and having a depth not higher than 5 mm.

22. A tread band according to claim 1, characterized in that the centre and intermediate ribs (5c, 5b) substantially have the same width.

23. A tread band according to claim 22, characterized in that each of said centre and intermediate ribs (5c, 5b) has a width included between 1/11 and 1/6 of the overall width of the tread band (1).

FIG. 1

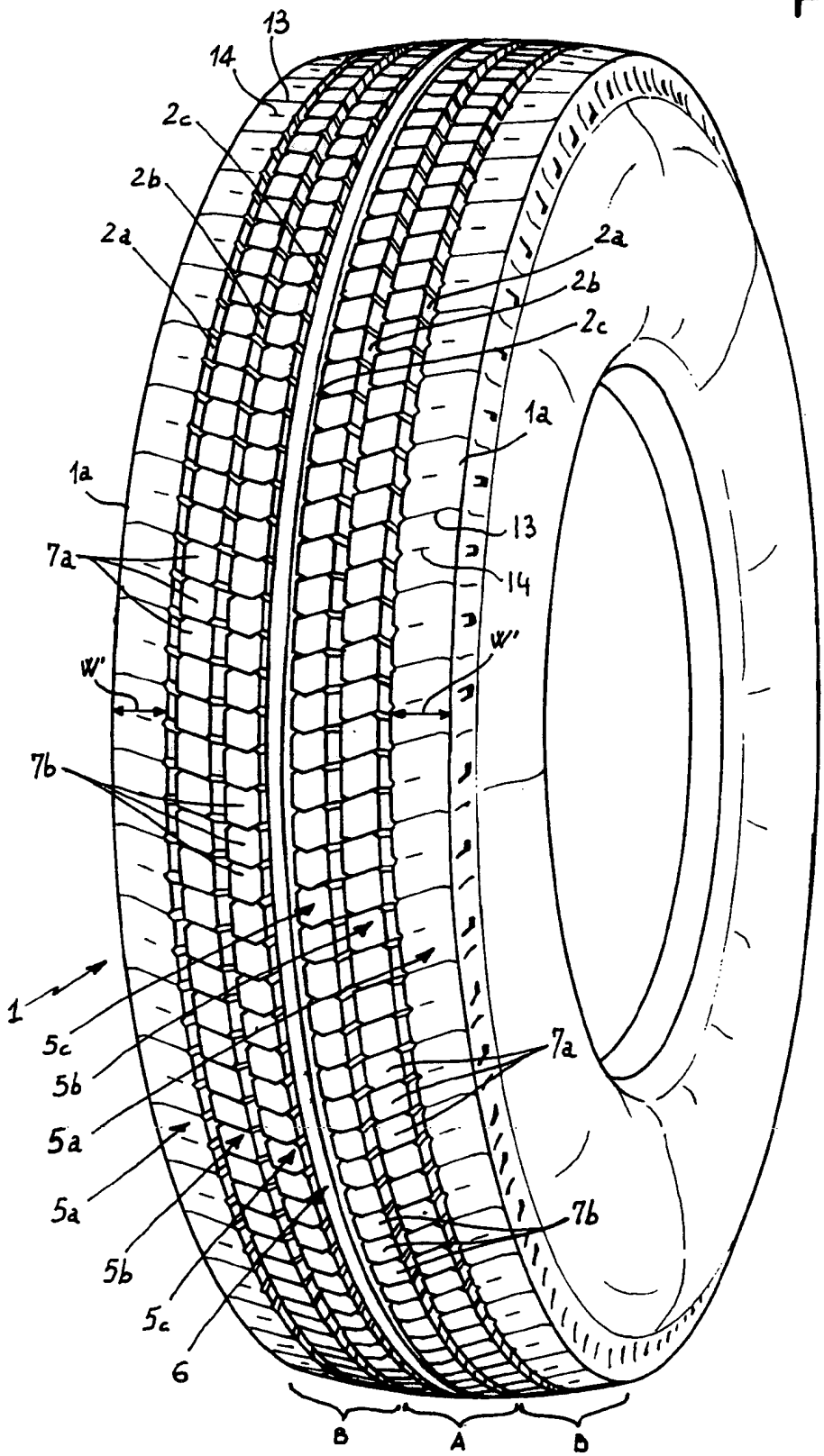

13
14
2c
2b
2a
2a
2b
2c
1a
1a
13
14
7a
W'
W'
7b
1
5c
5b
5a
5a
5b
5c
6
7a
7b
B
A
B

FIG. 2

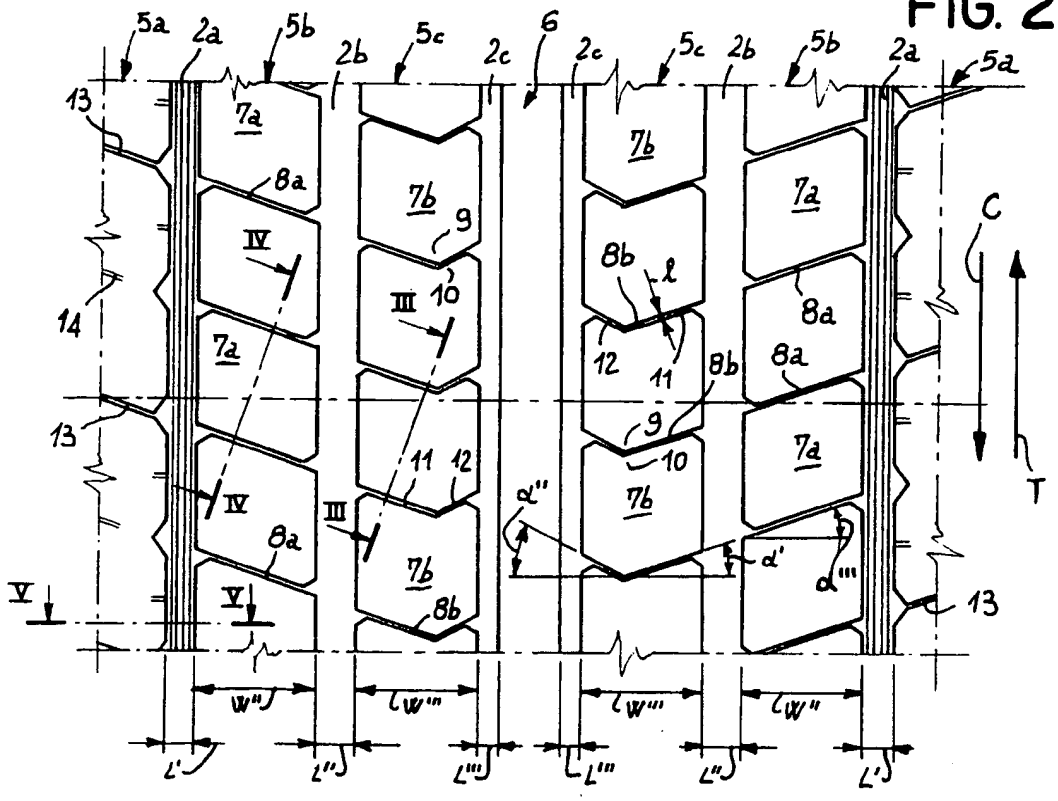
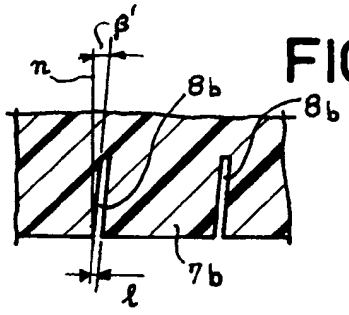


FIG. 3



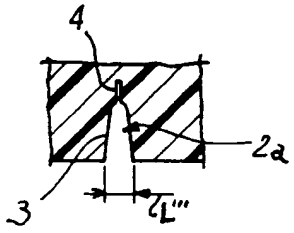
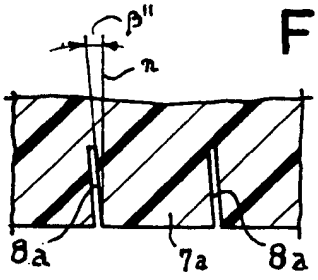


FIG. 5

FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 95 10 2220

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	PATENT ABSTRACTS OF JAPAN vol. 17 no. 679 (M-1527) ,14 December 1993 & JP-A-05 229315 (TOYO TIRE&RUBBER CO. LTD.) 7 September 1993, * abstract * ---	1,11,12	B60C11/04 B60C11/12
A	PATENT ABSTRACTS OF JAPAN vol. 17 no. 598 (M-1504) ,2 November 1993 & JP-A-05 178026 (TOYO TIRE&RUBBER CO. LTD.) 20 July 1993, * abstract * ---	1-5,8, 11,12	
A,D	EP-A-0 384 182 (MICHELIN & CIE) * claims; figures * ---	1,14-17	
A,D	EP-A-0 498 287 (MICHELIN RECHERCHE & TECHNIQUE S.A.) * claims; figures * ---	1,22	
D,A	FR-A-2 444 576 (PIRELLI SPA.) * claims; figures * ---	6,7,19, 20	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	GB-A-2 093 777 (THE GENERAL TIRE & RUBBER CO.) * claims; figures * -----	1,9,10	B60C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 May 1995	Baradat, J-L

CATEGORY OF CITED DOCUMENTS

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